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# Protocol based QoS Estimation of OFDM-WIMAX Network

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***Abstract*—The assortment of a suitable routing protocol is a key issue while scheming of a scalable and competent WIMAX network. This work emphasizes on the investigation of different routing protocols and to evaluate the superlative routing protocol in our proposed fading resistant OFDM-WIMAX network. The proposed work is investigated with respect to QoS parameters such as throughput, average delay, end to end delay (Uplink/Downlink), packet jittering, packet dropped (Uplink/Downlink). The obtained simulative results prop up the influence of different routing protocols such as OSPF, IS-IS, RIP and IG RP used in different scenarios.**

***Keywords*— WIMAX; QoS; Routing protocols.**

## I. INTRODUCTION

The IEEE 802.16 standard, known as WIMAX (Worldwide Interoperability for Microwave Access), is one of the most attractive solution developed in the last years for the wide adoption of broadband wireless access to metropolitan areas. It provides a larger coverage compared to WiFi while supporting sting QoS and security mechanism. However, this technology needs fine configurations tuning to achieve its performance, which implementation in different environments is very difficult for operators willing to deploy it [1]. WIMAX base stations can offer greater wireless coverage of about 5 miles, with the line of sight transmission within the bandwidth of upto 70 Mbps. Theoretically, the range of the WIMAX base station for broadband for wireless access achieved up to 50 km for fixed stations and 5-15 km for mobile stations with the maximum data rates up to 70 Mbps. The WIMAX forum is a group of 400 plus networking equipment vendors [2-5]. To provide sting QoS with long reach access, a suitable routing protocol needs to be accompanied with OFDM based WIMAX network [CIIT citation] A routing protocol shares information firstly among immediate neighbours, and then throughout the network. This way, routers gain knowledge of the topology of the network. There have been a number of routing algorithms presented and discussed. One of these is Routing Information Protocol (RIP), a distance-vector routing protocol, employs the hop count as a routing metric and prevents routing loops by implementing a limit on the number of hops.

A hop count of more than 15 is taken as unreachable, inoperable, or undesirable routes. Originally, each RIP router transmitted full updates every 30 seconds. Unlike early deployments, a massive traffic burst is used after every 30 seconds irrespective of random initialization [6]. This limited hop limit within large networks is overcome by another distance vector interior routing protocol (IGP) known as Interior Gateway Routing

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Protocol (IGRP). The maximum hop count of IGRP-routed packets is 255 (default 100), and routing updates are broadcast every 90 seconds (by default) [6]. IGRP supports multiple metrics for each route, including bandwidth, delay, load, MTU, and reliability to compare two routes. These metrics are combined together into a single metric, using a formula which can be adjusted through the use of pre-set constants. On contrary, OSPF computes the shortest path tree for each route using a method based on Dijkstra's algorithm, a shortest path first algorithm and was designed to support variable-length subnet masking (VLSM) or Classless Inter-Domain Routing (CIDR) addressing models [6]. OSPF detects changes in the topology, such as link failures very quickly and converges on a new loop-free routing structure within seconds. Additionally, Intermediate System to Intermediate System (IS-IS) is designed to move information efficiently within a computer network and is accomplished by determining the best route for datagram through a packet-switched network [6]. In this work, we have investigated different routing protocols in a proposed fading resistant OFDM-WIMAX network with respect to QoS parameters such as throughput, average delay, end to end delay, packet jittering, packet dropped which is not discussed in detail in previous research work.

## II. SIMULATION PLATFORM

The demonstrated fading resistant OFDM-WIMAX network [7] is designed using OPNET™ 14.5 consists of IPv4 enabled mobile nodes, with home agent set at BS_0. The MS node moves away from the Home Agent and visit seven Foreign Agents before returning back to the care of the Home Agent as shown in Fig 1.The other simulated parameters for our proposed system are depicted in Table I.

TABLE I. SIMULATION PARAMETER

| PARAMETER | VALUE |
|---|---|
| Subcarriers | 512 |
| Duplex Scheme | TDD |
| Frame Duration (msec) | 5 |
| Max. Transmission power (w) | 2 |
| OFDM Bandwidth(MHz) | 5 |
| Antenna Gain(dB) | 15 |

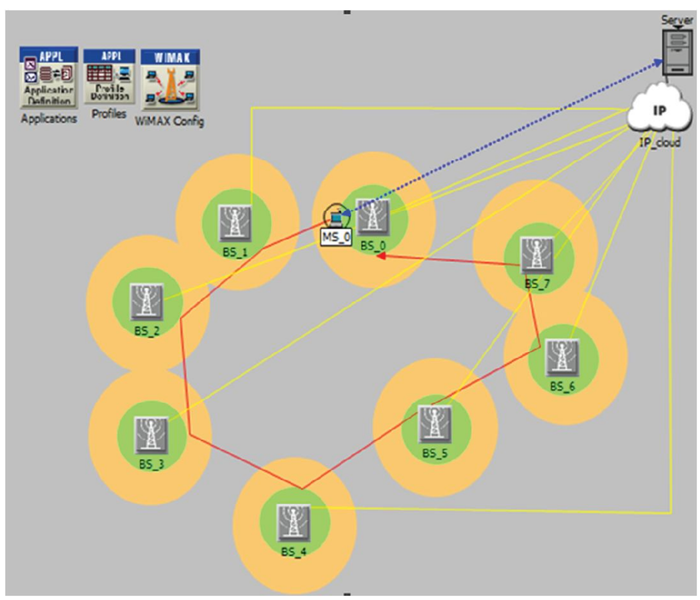


Fig. 1 Network Design of the project at position of the MS at Base Station 0 [7]

This section looks over the upshot of different routing protocols on the performance of OFDM-WIMAX network by executing four different scenarios.

The performance of each of these simulated scenarios is evaluated through QoS parameters. It has been observed that delay of base station 0 is maximum in case of IGRP protocol, almost same for IS-IS protocol and is stabilized around 0.035sec approximately. For RIP protocol, the delay is computed as 0.029 sec and is, then stabilized around 0.033sec. Delay is comparatively small for OSPF protocol and is measured as 0.029 sec but after simulation period of 45 mimutes, it is fixed to 0.033 sec as shown in Fig. 2.

Further, we have computed packet ETE delay (Uplink/Downlink). In case of propagation of data packets from MS to server, ETE is computed maximum initially for RIP protocol and is around 0.0363 sec, then reduces dramatically to 0.0346 sec after 5 minutes of simulation. After 50 minutes of simulation, it is stabilized and is measured as 0.0345 as shown in Fig. 3. It is further clear from the simulation results depicted in Fig. 3 that IGRP bears the least ETE delay in downlink propagation but maximum in uplink transmission of data packets as shown in Fig 4.

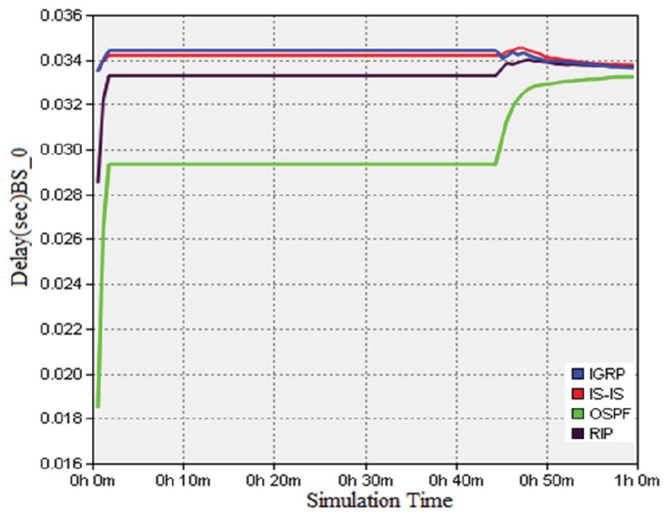


Fig. 2 Delay sec of Base Station 0

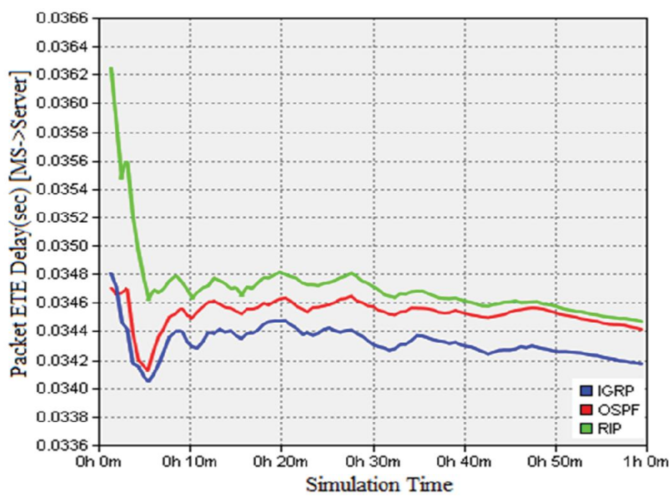


Fig. 3 Packet ETE Delay sec [Mobile Station -> Server]

Packet jittering is also assorted under the influence of different routing algorithms as shown in Fig.5. RIP bears maximum Packet jittering initially and with the increase in simulation period, it is stabilized to 0.0077sec after 1 hour. Least Packet jittering is measured in case of IGRP protocol, starts from 0.0070sec approximately, then increases to 0.0077sec after 10 minutes of simulation with minute variations and finally, reaches to 0.0076sec after 1 hour of simulation.

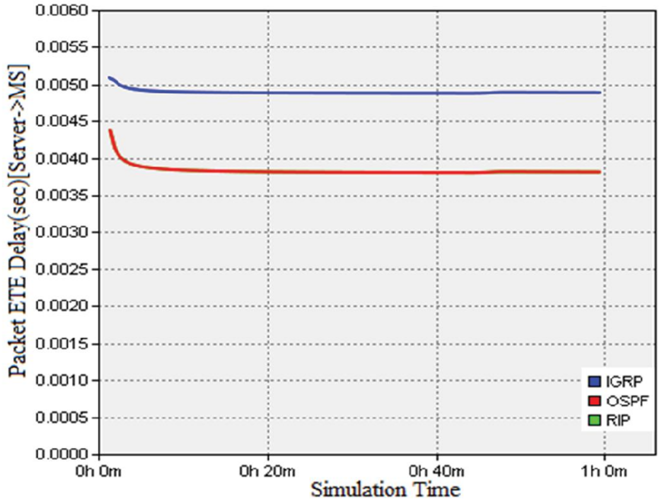


Fig. 4 Packet ETE Delay sec [Server->MS]

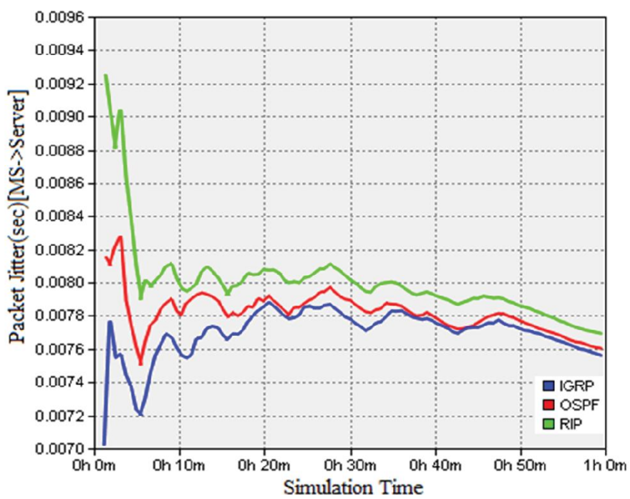


Fig. 5 Average Packet Jitter sec [MS->Server]

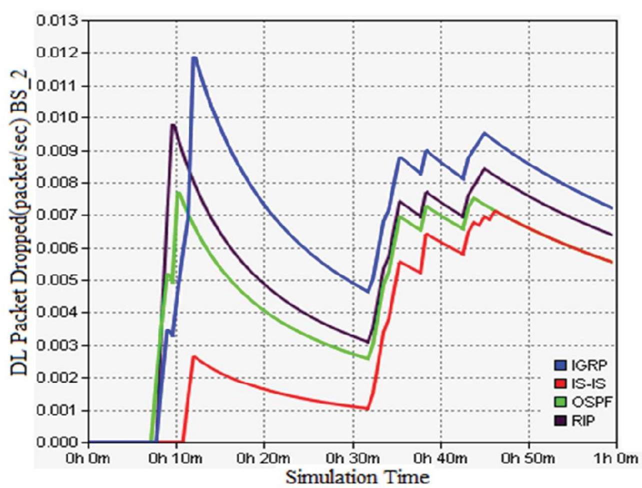


Fig. 6 Downlink (DL) Packet Dropped

Further, we have evaluated another QoS parameter i.e. Packet dropped in both the directions (uplink and downlink) under different algorithms. In case of downlink propagation of packets, maximum packets dropped are seen initially for all the simulated protocols and maximum for IGRP after a simulation period of 10 minutes. It has been also observed that this factor shows a sharp downfall in all the scenarios after a simulation period of 10-12 minutes as shown in Fig.6.During Uplink packet transmission, IGRP drops maximum number of packets throughout the simulation period as depicted in Fig. 7. WIMAX throughput is nearly same (max 120,000 bit/sec) for all the scenarios using IGRP,OSPF and RIP as shown in Fig.8.

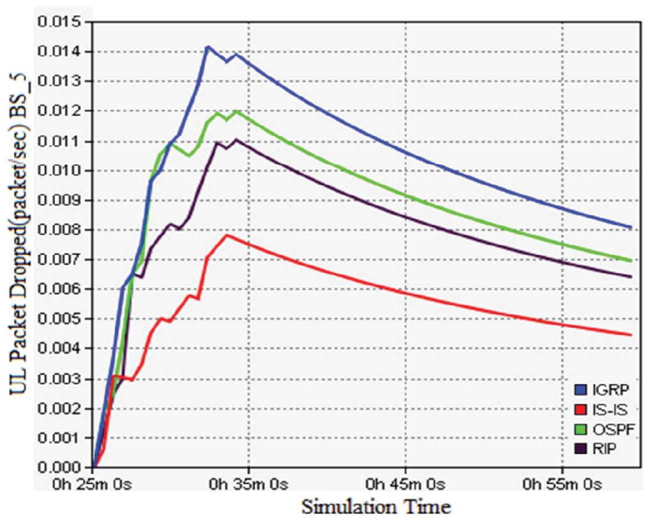


Fig. 7 Uplink (UL) Packet Dropped (packet/sec)

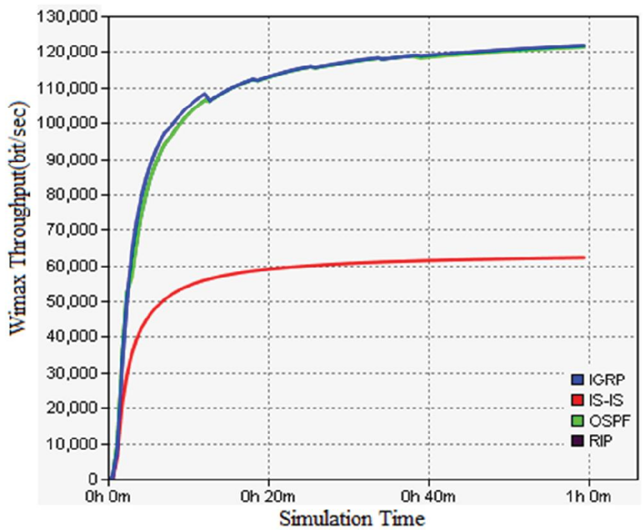


Fig. 8 WIMAX Throughput(bit/sec)

## III. CONCLUSIONS

A performance assessment of four different routing protocols is performed here using different OFDM-WIMAX scenarios. From the result of our studies, it is seen that performance parameters get influenced greatly and put the effect on the efficiency of the network under the influence of diversified simulated routing protocols in the demonstrated OFDM-WIMAX network. It is recommended to incorporate a superlative algorithm to increase the performance of OFDM-WIMAX network depending upon the requirements.

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